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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/666,195	09/19/2003	Gerd Marxsen	2000.109000	8808
23720	7590	02/17/2005	EXAMINER	
WILLIAMS, MORGAN & AMERSON, P.C. 10333 RICHMOND, SUITE 1100 HOUSTON, TX 77042			DOLAN, JENNIFER M	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 02/17/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/666,195

Applicant(s)

MARXSEN ET AL.

Examiner

Jennifer M. Dolan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 10-13 and 17-20 is/are allowed.
- 6) ☒ Claim(s) 1-4 and 7-9 is/are rejected.
- 7) ☒ Claim(s) 5, 6, 14-16 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. ____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>6/1/04; 9/7/04</u> . | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Claim Objections

1. Claims 14-16 are objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim should refer to other claims in the alternative only. See MPEP § 608.01(n). Accordingly, the claims have not been further treated on the merits.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 3, and 7-9 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Publication No. 2004/0094511 to Seo et al.

Regarding claims 1 and 3, Seo discloses a method of depositing a metal over a substrate (see figures 1-5) including a dielectric layer having patterned and non-patterned regions therein (see paragraphs 0022, 0026), the method comprising: exposing the substrate to an electrolyte bath so as to non-conformally deposit metal in a bottom-to-top technique in the patterned region (see paragraphs 0019-0023); forming an excess metal layer over the patterned region and substantially non-patterned region (see figure 4), and controlling at least one process parameter

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during the formation of the excess metal layer (paragraphs 0028-0030; 0055-0056) to adjust a surface roughness (paragraphs 0028-0030).

Regarding claim 7, Seo discloses that the metal is copper (paragraphs 0003-0005, 0022).

Regarding claim 8, Seo discloses that the patterned region may include vias having a diameter of 0.09 microns (paragraph 0006).

Regarding claim 9, Seo shows approximately equal surface roughness above the patterned and non-patterned region (figure 4).

4. Claims 1-3 and 7-9 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Publication No. 2004/0012090 to Basol et al.

Regarding claims 1-3, Basol discloses a method of depositing a metal over a substrate (see paragraphs 0003-0004) including a dielectric layer having a patterned region and a substantially non-patterned region formed therein (figures 1a, 1b, 2; paragraph 0006), the method comprising: exposing the substrate to an electrolyte bath for electroplating metal in a bottom-to-top technique in the patterned region (see paragraphs 0007-0008, 0029-0030); forming an excess metal layer over the patterned region and non-patterned region (figures 1b, 2); and controlling at least one process parameter during the formation of the excess metal layer (paragraph 0034-0038; the concentration of additives, including leveler concentration, is used to control the properties of the formed film) to adjust a surface roughness (the surface roughness is directly dependent upon the additive concentrations; also see paragraph 0052, 0054-0055).

Regarding claim 7, Basol discloses that the metal is copper (paragraph 0029).

Regarding claim 8, Basol discloses that the method is applied to vias having a diameter of approximately 0.1 micron (paragraph 0006).

Regarding claim 9, Basol discloses that the surface roughness above the patterned region and non-patterned region are approximately equal (figure 2, line 32; also, Basol uses a very small concentration of leveler, similar to that disclosed by applicant – see paragraph 0055).

5. Claims are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 2003/0221966 to Bonkass et al.

The applied reference has a common inventor with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention “by another,” or by an appropriate showing under 37 CFR 1.131.

Regarding claims 1 and 3, Bonkass discloses a method of depositing a metal over a substrate including a dielectric layer having patterned and unpatterned regions therein (figure 1d; paragraph 0006), comprising: exposing the substrate to an electrolyte bath for electroplating a metal in a bottom-to-top technique in the patterned region (paragraphs 0017, 0039); forming an excess metal layer over the patterned and non-patterned regions (paragraphs 0038-0042); and controlling at least one process parameter (additive concentration and plating time) during the formation of the excess metal layer to adjust a surface roughness of the excess metal layer

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(paragraphs 0035, 0039; adjusting the additive concentrations automatically adjusts the surface roughness).

Regarding claim 4, Bonkass discloses removing the excess metal by CMP using an endpoint detection signal (paragraph 0045).

Regarding claim 7, Bonkass discloses that the metal is copper (paragraph 0011).

Regarding claim 8, Bonkass discloses that the vias have a width of approximately 0.1 microns (paragraph 0004, 0006, 0046).

Allowable Subject Matter

6. Claims 10-13 and 17-20 are allowed.

7. Claims 5 and 6 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter:

The primary reason for allowability is the inclusion in claims 5 and 6 of adjusting one of the process parameters causing surface roughness of a electroplated film based on an endpoint detection signal, the inclusion in claims 10-13, 17, and 18 that the surface roughness is greater than 50 nm in order to promote planarization of the metal layer, and the inclusion in claims 19 and 20 of a step correlating a measured surface roughness before a CMP process with an endpoint signal or CMP duration. Although the prior art of record does suggest that the planarity and roughness of an electroplated copper layer is dependent upon the concentration of various

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additives, and the prior art further teaches planarization (such as CMP) following the electroplating, where an endpoint monitor is used to end the planarization, there is no fair suggestion in the prior art of advantageously roughening the surface in order to promote CMP or selecting electroplating process parameters based on the parameters of the following CMP process.

Generally, the prior art either teaches methods to avoid CMP altogether, such as ECMPR or deplating, or the prior art teaches multiple deposition steps in order to attain a reasonably planar metal surface. Since the present invention teaches advantageously roughening an electroplated metal by altering the additive concentrations in order to avoid dishing and erosion in CMP with both wide and narrow trenches, as well as means for optimizing the degree of roughness required for evenly planarizing the regions above both the narrow vias and the wide features, it is the examiner's opinion that such method steps extend well beyond the teachings available to one having ordinary skill in the art.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- a. U.S. Patent Publication No. 2003/0162399 to Singh discloses methods for performing CMP on copper interconnects formed in a soft dielectric layer.
- b. U.S. Patent Publication No. 2003/0080000 to Robertson teaches methods for measuring additive concentrations.

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c. U.S. Patent No. 5,232,575 to Dodd teaches general properties of additives added to an electroplating bath.

d. U.S. Patent No. 6,444,110 to Barstad et al. teaches the relationship between accelerator concentration and the electroplated film quality.

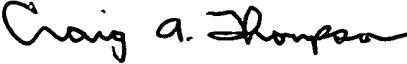
.Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
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jmd


CRAIG A. THOMPSON
PRIMARY EXAMINER